MOVE FROM GAS TO COAL: ENERGY SECURITY ISSUES

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FROM GAS TO COAL : ENERGY SECURITY ISSUES CHALLENGES FOR MALAYSIA

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I. INTRODUCTION

From gas to coal? Are we taking a step backwards, when the logical trend for environmental consideration is the need to move away from coal to gas which is a more environment friendly fuel. Despite currently being a net exporter of oil and gas, the realization that oil is no longer to be taken for granted as cheap and plentiful energy resource, particularly after the 1980s oil shocks, resulted in Malaysia pursuing energy policy objectives based on the availability of indigenous energy resources, its relative costs and effect on the environment. In line with this thrust, long-term objectives are aimed at reducing dependence on oil as a single energy source, ensuring adequate and reliable energy supply, as well as achieving higher utilization efficiency.

II. MALAYSIA'S ENERGY POLICY

Malaysia's National Energy Policy (1979) aims to have an efficient, secure and environmentally sustainable supply of energy in the future as well as to have an efficient and clean utilization of energy. The three primary objectives of the economy's energy policy relate to the supply, utilization and environmental factors.

Supply Objective
To ensure the provision of adequate, secure and cost-effective energy supply by developing indigenous energy resources (both non-renewable and renewable), using least-cost options and to diversify supply sources (both from within and outside the economy).

Utilization Objective
To promote the efficient utilization of energy and discourage wasteful and non-productive patterns of energy consumption.

Environmental Objective

To ensure that factors pertaining to environmental protection are not neglected in the pursuit of the supply and utilization objectives. Environmental challenges facing the energy sector cover climactic change, air and water pollution as well as solid waste, which are mainly caused by the increasing use of fossil fuels.

In achieving the above objectives, other energy-related policies, such as the National Depletion Policy (1980) and Four-Fuel Diversification Policy (1981), were formulated. The National Depletion Policy is intended to conserve the economy's energy resources, particularly oil and gas. In this respect, production of crude oil is limited to about 600,000 barrels per day, whilst that of natural gas to 2,000 million standard cubic feet per day (mmscfd). Meanwhile, the Four-Fuel Diversification Policy was designed to reduce the economy's over-dependence on oil as a source of energy. The policy focuses on four main sources of fuel, namely oil, hydro, gas and coal, aimed at ensuring their reliability and security of supply, whilst reducing the dependence on oil in energy consumption. To further enhance efforts in ensuring sustainable development of energy resources, utilization of renewable energy (RE) as the fifth fuel will be promoted to supplement the supply from the conventional energy sources.

III. ENERGY SCENARIO IN MALAYSIA

During the past two decades, demand for commercial energy grew rapidly and exceeded the growth of the economy. Demand increased at an average rate of 7.5 percent in the 1980s and 7.7 percent in the 1990s, compared with a GDP growth of 5.9 percent and 7 percent over the corresponding period.

When viewed from the source perspective, demand for energy increased from 267.3 petajoules in 1980 to 1,167.1 petajoules in 2000, as shown in **Table 1**. The main demand was for petroleum products (68.9 percent of total energy demand in 2000), followed by electricity (17.6 percent), natural gas (10.3 percent) and coal and coke (3.2 per cent). Although petroleum products remains to be the leading source of energy, the demand for petroleum products had declined from 86.9 per cent in 1980 to 68.8 percent in 2000, reflecting the efforts taken to restructure the energy consumption pattern. Meanwhile, final consumption of natural gas grew from 0.6 percent to 10.3 percent over the same period.

Table 1
Final Commercial Energy Demand by Source, 1980-2005 (petajoules)

Source	1980	1990	1998	2000	2005
Petroleum products	232.4 *(86.9%)*	414.0 *(74.8%)*	714.1 *(69.2%)*	804.3 *(68.9%)*	1,139.1 *(67.0%)*
Electricity	31.2 *(11.7%)*	71.8 *(13.0%)*	184.7 *(17.9%)*	205.0 *(17.6%)*	320.0 *(18.8%)*
Natural gas	1.5 *(0.6%)*	45.7 *(8.3%)*	100.0 *(9.7%)*	120.0 *(10.3%)*	184.8 *(10.9%)*
Coal & coke	2.2 *(0.8%)*	21.5 *(3.9%)*	33.2 *(3.2%)*	37.8 *(3.2%)*	55.9 *(3.3%)*
Total	**267.3** ***(100%)***	**553.0** ***(100%)***	**1,032.0** ***(100%)***	**1,167.1** ***(100%)***	**1,699.8** ***(100%)***

Source: Eight Malaysia Plan (2001-2005)
Mid-term Review of the Seventh Malaysia Plan (1996-2000)
National Energy Balance, Malaysia (1980-1997)

In terms of supply, the total supply of energy increased from 391.8 petajoules in 1980 to 1,674 petajoules in 2000, as shown in **Table 2**. The main sources of energy supply were crude oil[1] and petroleum products (53.1 percent of total energy supply in 2000), followed by natural gas[2] (37.1 percent), coal and coke (5.5 percent) and hydro (4.4 percent). There was a significant decline in the share of crude oil and petroleum products from 87.6 percent in 1980 to 53.1 percent in 2000, indicating successful efforts to reduce the overall dependence on a single source of energy and develop alternative sources of supply. In this regard, the development of the domestic gas industry has increased the supply of natural gas from 7.5 per cent to 37.1 percent over the same period.

[1] Crude oil reserves are estimated at 3.39 billion barrels to last for 15 years
[2] Natural gas reserves are estimated at 82.5 trillion standard cubic feet to last for 32 years

Table 2
Primary Commercial Energy Supply by Source, 1980-2005 (petajoule)

Source	1980	1990	1998	2000	2005
Crude oil & petroleum products	344.4 *(87.9%)*	520.2 *(71.4%)*	804.8 *(55.6%)*	888.4 *(53.1%)*	1,205.2 *(50.8%)*
Natural gas	29.2 *(7.5%)*	114.4 *(15.7%)*	504.5 *(34.8%)*	622.2 *(37.1%)*	948.4 *(39.9%)*
Hydro	16.0 *(4.1%)*	38.2 *(5.3%)*	59.1 *(4.1%)*	73.0 *(4.4%)*	81.6 *(3.4%)*
Coal & coke	2.2 *(0.5%)*	55.5 *(7.6%)*	79.9 *(5.5%)*	90.4 *(5.4%)*	139.6 *(5.9%)*
Total	**391.8** ***(100%)***	**728.4** ***(100%)***	**1,448.3** ***(100%)***	**1,674.0** ***(100%)***	**2,374.8** ***(100%)***

Source: Eight Malaysia Plan (2001-2005)
Mid-term Review of the Seventh Malaysia Plan (1996-2000)
National Energy Balance, Malaysia (1980-1997)

The fuel mix for power generation is also based on the four-fuel diversification policy but there are no pre-determined targets for the share of each fuel type (oil, natural gas, coal and hydro). The implementation of the diversification policy resulted in a major reduction in the dependency from oil in the 1970s to increased usage of gas in the 1990s. In 1990, oil which made up 41.9 percent of the fuel mix is reduced to 5.3 percent in 2000 while utilization of gas increased from 26.2 percent to 78.7 percent, as shown in **Table 3**. Currently, the utilization of oil is by standby plants in Peninsular Malaysia and isolated oil-fuelled generation sets in Sabah and Sarawak. The successful diversification and switch from oil to gas in the power sector came about due to the development of the gas infrastructure the Peninsular Gas Utilization Project in Peninsular Malaysia, the greater preference for more efficient technologies particularly by the independent power producers (IPPs) and the need to consider and utilize domestic resources.

Table 3
Fuel Mix in Electricity Generation, 1990-2005
(%)

Year	Oil	Coal	Gas	Hydro	Others	Total (gigawatthour)
1990	*41.9*	*13.8*	*26.2*	*17.8*	*0.3*	**22,768**
1995	*11.0*	*9.7*	*67.8*	*11.3*	*0.2*	**41,813**
2000	*5.3*	*7.9*	*78.7*	*8.0*	*0.1*	**69,371**
2005	*3.0*	*30.3*	*61.0*	*5.4*	*0.3*	**102,340**

Source: Eight Malaysia Plan (2001-2005)
Seventh Malaysia Plan (1996-2000)

The above trends on the energy consumption and supply patterns as well as the fuel mix for electricity generation demonstrate the success of the current energy policies pursued, namely the National Depletion Policy and Four-Fuel Diversification Policy. Although the demand for natural gas is on the increasing trend, the economy's overall energy mix will be continuously reviewed so as to ensure the long-term reliability and security of energy supply.

III. CHALLENGES IN FUTURE COAL UTILIZATION IN THE MALAYSIAN POWER SECTOR

The use of coal in electricity generation was initiated with the commissioning of Tenaga Nasional Berhad (TNB) first coal-fired plant of two units of 300MW at Kapar, Port Klang in 1988. Partly due to environmental reasons, it took about 10 years before another two coal-fired units of 300MW were commissioned at Kapar. In Sarawak, the 100MW coal-fired plant in Sejingkat was commissioned in 1998. The economy's coal-fired plant capacity will be expanded with the commissioning of the 2,100MW TNB Janamanjung plant in Perak and another two IPP-operated plants of 2100MW and 1400MW. The trend towards coal provides a practical approach in optimizing the fuel mix and reduce the over-dependence on a single fuel.

However, the energy sector is generally undergoing tremendous changes in terms of technology, investments and regulatory framework. These changes will require constant review of policies and adaptation of new strategies. There is also the need to intensify current efforts in productivity and efficiency improvements as well as provide a catalyst for fast take-off of renewable energy projects in order to ensure a more sustainable development of the energy sector. If

these could be implemented successfully, it will definitely contribute towards the enhancement of the competitiveness of the economy. The main challenge then is to ensure adequate, secure and cost-effective supply of energy.

a. Promoting Investments in Coal-fired Plants

Initial capital outlay of a coal power plant is relatively higher than a gas combine cycle power plant, it requires longer construction time and additional infrastructure as well as logistically constraining choice of site. The challenge is to provide an attractive climate for investments in coal power plants. In this regard, the experience in developing the TNB Janamanjung coal plant will be used as a benchmark for future competitive Power Purchase Agreements (PPAs) with new investors in coal-fired plants.

b. Technology

Modern technologies will be critical in remedying environmental damage that is generated from coal supply and combustion as well as improving the economics of coal-based generation. This urgent need to reduce environmental degradation, the clean coal technology – has become a mandatory requirement in Malaysia. It is necessary to facilitate sustainability of coal in the generation mix, and its investments cost. Our only concern being, this technology is still relatively expensive and the cost of pollution control eventually are channeled to the consumer through the selling price of the electricity to the utility. The difficulty and challenge is to ensuring the balancing of returns to the project and the need to have minimal impact on the selling price of electricity to the consumers. The balancing act between making investments work and the need to provide electricity at an affordable price remains a challenge.

c. energy – environment integration

Energy and environmental planning must be fully integrated. Energy planning has increasingly becomingly complex and has extended beyond supply issues but also behavorial changes and social costs. Economics and fiscal measures are becoming important features for policy implementation while technical efficiency and productivity improvements become critical factors for consideration. The fundamental challenge is the delicate need to maintain the economics as well as the environmental objective of the economy. As all of us are aware, coal by its nature could easily contribute to the worsening of the environment if mitigating factors such as emission control, stringent environmental measures, and the adoption of clean coal technology are neglected. All these factors overwhelmingly increases the costs of electricity production which nullifies the effort of the Government to provide a basic need at a

reasonable and affordable price to the general consumers. This difficult need to balance the economic and social objectives will require major fine tuning of approaches of project evaluation, implementation and planning while transition arrangements for market-based options must constantly be developed in line with the readiness of the economy and the consumers. These are challenging indeed, not only for the planners, the regulators, the financiers but also to the investors.

d. indigenous coal supply

Although Malaysia import more than 90 per cent of its coal consumption, Malaysia does have a good reserve of bituminous, anthracite and semi-antracite with low to medium volatiles, low ash, very low sulphur and high gross calorific value from 7,000 – 8,000kcal/kg. A total estimated 1,031.4 million tones reserves have been estimated where 175 million tones are proven,113 million indicated and 686 million tones inferred reserves. The largest coal deposits are located in the Merit-Pila are in central Sarawak and the Meliau basin in the south-central Sabah. Another 22 coal seams with thickness of 0.3 to 1.8meter have also been identified in the Tutuh coal field. The latter deposits were discovered in surveys conducted in the year 2000. These are reserves, at this point uneconomic to mine, however, should there be any external supply or foreign exchange constaints, this indigenous supply of fuel can be utilized to ensure reasonably secure supply of resources.

VI. CONCLUSION

Coal has been introduced into the Malaysian energy mix for more than a decade. There were lessons learnt and there were positive results in technological absorption and frontier enhancement. New growth areas relating to the provision and support infrastructure and services for coal have been established and developed. The mandatory clean coal technology is expected to reduce the negative environmental impact of power generation. Combining market-driven mechanisms and instruments, energy efficiency efforts, conservation investments, continued fuel supply diversification and the expansion of indigenous energy production, technology and capabilities are the challenges in ensuring the sustainability of coal utilization. All in all, coal if properly balanced into the energy mix will provide the strategy to balance between adequate, secure energy supplies, economic growth and protection of the environment.

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Malaysia National Energy Policy (1979)

3 objectives relate to:

- Supply
- Utilization
- Environment

Other Energy-related Policies

- National Depletion Policy (1980)
- Four-Fuel Diversification Policy (1981)

Energy Scenario in Malaysia

Demand for Commercial Energy
- petajoule

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Energy Supply by Source
– petajoule

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- %

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2005	*3.0*	*30.3*	*61.0*	*5.4*	*0.3*	102,340

Energy Mix Optimization

- Energy Mix continuously reviewed to ensure long term reliability and security of supply
- Optimize fuel diversification mix and reduce over-dependence on a single fuel

Challenges in Future Coal Utilization

- Promoting Investments
- Technology
- Energy-environment Integration
- Indigenous Coal Supply